

Tracking the depleted mantle signature in melt inclusions and residual glass of basaltic martian shergottites using secondary ionization mass spectrometry

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Abstract:

Trace element abundances of depleted shergottite magmas recorded by olivine-hosted melt inclusions (MI) and interstitial mesostasis glass were measured using the Cameca ims-1270 ion microprobe. Two meteorites: Tissint, an olivine-phyric basaltic shergottite which fell over Morocco July 18th 2001; and the Antarctic meteorite Yamato 980459 (Y98), an olivine-phyric basaltic shergottite with abundant glassy mesostasis have been studied.

Chondrite-normalized REE patterns for MI in Tissint and Y98 are characteristically LREE depleted and, within analytical uncertainty, parallel those of their respective whole rock composition; supporting each meteorite to represent a melt composition that has experienced closed-system crystallization. REE profiles for mesostasis glass in Y98 lie about an order of magnitude higher than those from the MI; with REE profiles for Tissint MI falling in between. Y98 MI have the highest average Sm/Nd and Y/Ce ratios, reflecting their LREE depletion and further supporting Y98 as one of our best samples to probe the depleted shergottite mantle.

In general, Zr/Nb ratios overlap between Y98 and Tissint MI, Ce/Nb ratios overlap between Y98 MI and mesostasis glass, and Sm/Nd ratios overlap between Y98 mesostasis glass and Tissint MI. These features support similar sources for both, but with subtle geochemical differences that may reflect different melting conditions or fractionation paths during ascent from the mantle. Interestingly, the REE patterns for both Y98 bulk and MI analyses display a flattening of the LREE that suggests a crustal contribution to the Y98 parent melt. This observation has important implications for the origins of depleted and enriched shergottites.